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The epigenome as a vector of inheritance: Evidence in mammals involving the germline

Abstract:
Behavior and physiology in mammals are strongly influenced by life conditions, particularly during early postnatal life. While positive factors can favor proper development and normal mental and physical health in adulthood, negative events such as traumatic experiences can cause psychiatric, metabolic and psychosomatic diseases. Such disorders are usually marked in individuals directly exposed but strikingly, they can also affect their offspring. The biological mechanisms underlying the transmission of experience-induced symptoms from parent to offspring have recently started to be examined and are thought to involve epigenetic mechanisms. This talk will present an experimental model of postnatal trauma in mice and show evidence that epigenetic factors are implicated in the expression and the inheritance of the effects of trauma. This model has depressive symptoms, increased risk-taking, altered social behaviors, cognitive deficits, and impaired blood and brain metabolism in adulthood. The symptoms are pronounced and persist throughout life, and are transmitted to the following offspring by both females and males and in up to the 4th generation. They are associated with epigenetic alterations involving persistent changes in DNA methylation at the promoter-associated CpG island of several genes, in the brain of the offspring and the germline of their father. Further to DNA methylation, other epigenetic mechanisms involving regulation by non-coding RNAs are also involved, those with causal consequences. Initial translational analyses in humans exposed to early life trauma validate these results. Overall, the findings suggest that epigenetic processes contribute to the impact of environmental exposure in postnatal life on adult behavior and physiology, and to its inheritance across generations.